Project Report: Impacts and the Evolution of Planetary Atmospheres

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Project Progress

Recent work has shown that large impacts (10 times the impactor mass and energy of a K/T–size event) may not erode planetary atmospheres. William Newman and colleagues consider the energetics of large bolide impacts on atmosphere–free planets in an attempt to determine whether these large impacts will contribute to or erode from the planet's volatile inventory. Their results show, for a wide range of impact speeds and for all but the most highly oblique impact angles, that volatile material will be added to the planet's inventory, especially if the planet has been depleted in volatiles as we assume Earth to be following the giant impact. For Venus, the situation is much the same as for Earth as it is for Mars, although for Mars the range of impact speeds is greatly reduced. Volatile retention depends primarily on the planet's escape velocity and the bolide's impact speed and angle of entry, with gravity being the truly dominant factor in these impacts. Following the giant impact, it is possible to acquire enough volatiles through impacts to account for the Earth's present–day inventory, without requiring significant degassing of surface volatiles and mantle outgassing, both of which seem unlikely following the giant impact. Results are described in Mischna, M.A. and Newman, W.I., "Atmospheric Accretion on Airless Planets: The Role of Oblique Impact Events," submitted to Planetary and Space Sciences, May 2004, 42 pages.

Roadmap Objectives

- ***Objective No. 1.1:*** Models of formation and evolution of habitable planets